BRITISH JOURNAL OF OPHTHALMOLOGY.

INCORPORATING

THE ROYAL LONDON OPHTHALMIC HOSPITAL REPORTS.

THE OPHTHALMIC REVIEW.

AND

THE OPHTHALMOSCOPE.

Editor:

E. E. MAUCHAN.

F. A. WILLIAMSON-NOBLE.

Assistant Editors:

H. E. SQUIRRELL.

Editorial Committee:

Sir John Herbert Parsons, C.B.E., D.Sc., F.R.C.S. (Consulting Surgeon, Moorfields); Sir William Lister, K.C.M.G., A. Bagnall Lloyd, F.R.C.S. (Ophthalmic Surgeon, Royal Infirmary, Liverpool); and Tom Reuters.

Correspondents:

J. H. Parsons (London); A. F. MacCallan (Glasgow); J. Herbert Fisher (Birmingham); R. R. Chambers (Bristol); A. Maitland Ramsay (Edinburgh); A. A. Duthie (Aberdeen); F. B. M. Adair (Oxford); [illegible] (Scotland); A. Hy. H. Swanzy, R. M. Traquair (Dublin); [illegible] (Ireland); James A. Ballantyne (Glasgow); [illegible] (Manchester); James Craig (Belfast); [illegible] (Wales); E. G. [illegible] (Liverpool); Lt.-Col. F. O'Donel (Bombay); [illegible] (Cape Town); [illegible] (Australasia); F. Pearson (Madras); [illegible] (Canada); A. G. [illegible] (Jamaica); O'Arcy Williams (Sydney); [illegible] (Egypt); [illegible] (Somerset); Simson (Brisbane); Sir H. Herbert Perceval, K.C. (New Zealand); [illegible] (Canada); [illegible] Gordon Sykes, [illegible] (Malta); [illegible] (Jamaica); [illegible] (Jamaica); G. B. Bouchier (Wellington).

LONDON:

THE BRITISH JOURNAL OF OPHTHALMOLOGY, LTD.

[illegible] Tavistock Square, W.C.1.

Annual Subscription, Single Copies, and Advertisements [illegible]

Annual Subscription [illegible] Foreign Postage, Post Free.

Telephone [illegible]

MAYFAIR 4242 (2 lines)

JOHN WEISS & [illegible] LTD

Surgical Instrument [illegible]

287, OXFORD [illegible]

ESTABLISHED [illegible]

ROYAL MEDICAL APP[illegible]

LONDON, 1913. [illegible] 1924. MADRID [illegible] PARIS, 1925

CARRYING CASE FOR EYE INSTRUMENTS, in black leather, lined with silk velvet, fitted with [illegible] scissors, etc., rack for knives and needles, with [illegible] for speculum, trephines, probes, etc., with carrying handle [illegible]

Glass Eye Shells are now available from stock [illegible] sizes.
Plain 3/3 each. Perforated [illegible]

See also p. [illegible] Advertisement

THE BRITISH JOURNAL
OF
OPHTHALMOLOGY

NOVEMBER, 1943

COMMUNICATIONS

ON A METHOD OF EVALUATION OF BINOCULAR MUSCLE BALANCE*

BY

Major D. D. STENHOUSE STEWART, R.A.M.C.

IN the pages of this journal (Vol. XXV, Nos. 4 and 5, April and May, 1941) Nigel Cridland fully discussed the academic aspects of orthophoria and heterophoria with a comprehensive bibliography.

The static measurement of the amount by which the visual axes deviate from the truly parallel when deprived of the stimulus of attention, fusion, and ciliary activity is no simple matter; the cadaveric state is as pathological a condition as is that of complete ophthalmoplegia. The position of rest, defined as a function of one or other of these, or in terms of dissociation from all neuromuscular control, is a hypothetical concept which cannot be measured in those alive and healthy. Nor is it particularly relevant to their visual comfort, though some approximate estimate can be made by the use of a Maddox rod, a remote point source of light, and interchangeable prisms in a condition of absolute cycloplegia. It is beginning to be more generally realised, however, that routine cycloplegia for the prescription of spectacles is as little logical as general anaesthesia for fitting shoes or clothes,

* Received for publication, July 5, 1943.

the suitability of which is only remotely influenced by precise static anatomical measurement. The state of emmetropia is well so named; normal binocular balance could better be known as *euphoropsia* than *orthophoria*, to convey not only anatomical precision but also the psychological implication of comfort in a dynamic sense. The amounts of "uncorrected" deviation from orthophoria that are tolerable are not exact and invariable for all patients alike.

Each oculist acquires by experience alone an assessment of the personal factor and an opinion on the appropriate measures likely to relieve symptoms of visual discomfort. This experience as it relates to the correction of errors of refraction is gained at first consciously from the painstaking evaluation of each case examined by the post-graduate student. By the everyday routine of his professional life it is subsequently and continually facilitated and refined; experts differ little from a uniform opinion upon the dioptric power of any spectacles necessary to relieve symptoms in a given case.

The subject of muscle balance is one in which the student takes an early interest, involving an expenditure of time and the use of unaccustomed equipment that is not practicable in every case. The discovery that considerable degrees of heterophoria can co-exist with euphoropsia causes him to renounce his interest as unprofitable.

The phoria requirements for comfortable near vision have become in a measure recognised as a result of the simple and speedy tests available. Near point tests give partial information only; the author believes that practical merit attaches to an equally rapid method of estimating, as a part of routine eye examination, the dynamic ocular equilibrium for distance; and that daily familiarity with the variability of these functions and their association with visual comfort will reconcile prevalent exaggerated scepticism and enthusiasm about the whole subject.

Instrumental additions are:—

(1) A pair of 7 dioptre prisms bases out in a hand spectacle frame (Fig. 1).

FIG. 1.

(2) A spring mount with a thin handle to take a single trial lens (in this instance a 2 dioptre prism as in Fig. 2).

Distance fixation targets are necessary, white on a black ground, at the customary six metres from the patient. They may be contrived very conveniently in conjunction with a scotometry screen of black velours cloth, 54 inches square, before the centre of which a Snellen chart is hung at a suitable height. Above the distance test type a 3 inch square of white card is pinned to hang diagonally by one corner and described as a diamond. On the left, at the

FIG. 2

horizontal centre, is pinned a ring of white card, of $1\frac{1}{2}$ inch internal and 3 inch external diameter. (This has another use in plotting a central scotoma.) A small white button about $\frac{1}{2}$ inch in diameter is pinned to a corresponding point on the right of the test type. The screen, fixation objects, and test type are illuminated by a single bulb above and in front, in a Holophane reflector fitting with a ventilated "gallery." This has proved as suitable as any more elaborate system, in that it gives an even light of adequate intensity free from disturbing reflections even though the Snellen type be framed under glass (Fig. 3).

(1) *Test for Eso- or Exo-Phoria.*—The patient, wearing a trial frame containing the lenses appropriate for distance, correctly centred, is told to look at the ring. The hand frame is held vertically by the examiner so that one prism is base down before the

FIG. 3.

right eye. If the patient fails to see a second ring displaced above the first, even with repeated removal and replacement of the prism, marked suppression or suspension of vision of one eye can be assumed. If no movement of the fixation object is observed, the right is the suppressing eye. (This can be verified or refuted by repeating the test with the prism before the left eye.) If a second image is seen, the patient states whether the higher image is to the right or left of the lower. The hand frame is tilted in the frontal plane until one image is vertically above the other, the amount of tilt giving an indication of the esophoria or exophoria. (The horizontal effect is 7 x tangent of angle of tilt. 45° is equivalent to 5 dioptres. A greater amount than this is unusual, and further tilting so reduces the vertical separation as to be impracticable, in which case supplementary prisms must be inserted in the trial frame base-apex line horizontal. It would, of course, be possible to elaborate this test by use of a variable prism or by a plumb-bob goniometer calibrated in prism dioptres, but our aim is simplicity.)

(2) *Crude Test for Hyperphoria (and Negative Relative Convergence).*—The patient's attention is next directed to the diamond.

The hand frame is held horizontally, so that one 7 dioptre prism is base in before the right eye. Spontaneous fusion may occur, but if two diamonds are seen, the outer end of the hand frame is raised or lowered in the frontal plane until they are level. The patient is then asked to bring them into one. The ability to overcome 7 dioptres base in from a state of orthophoria and emmetropia (natural or artificial) implies very full euphoropsia with ample negative relative convergence at distance. If necessary, fusion may be encouraged by a glance at the test types.

(3) Test for Positive Relative Convergence.—The patient continues to look at the diamond, and the hand frame is held before both eyes. This gives an effective 14 dioptres base out. The attainment of fusion now demands fourteen prism dioptres of convergence. It sometimes occurs spontaneously; if not, the examiner's finger may be held erect between patient and fixation object, about a metre from the patient, as a convergence stimulus. When fusion of finger images is effected, the patient may be able at the first or subsequent attempt to transfer his gaze to the diamond, at the same time sustaining fusion. Persistent failure implies that the fusion wish or the power of convergence is weak. Ability to maintain fusion and to read as far as before on the test types will prove that the convergence is "relative." (The hand frame itself is a practicable "home exerciser" whether of convergence or divergence, at a distance or at the near point.)

(4) Critical Test for Hyperphoria.—The fixation button and a 2 dioptre prism in the handle mount are used only for the assessment of hyperphoria and of the need for correction. With the handle horizontal, the effect obtained is that of two dioptres of prism base up (or down) before one eye with a corresponding vertical image separation. Spontaneous fusion should be rapid. By a twist of the handle between finger and thumb the examiner creates the opposite state or artificial vertical imbalance and may repeat this manoeuvre several times (not too often if he values the favourable opinion of his patient) observing on each occasion an equal ease of recovery of fusion. Success in this implies that the hyperphoria present, if any, is easily within the patient's tolerance. If fusion in one position of the handled prism is easy but impossible in the obverse position, supplementary prisms of various low powers, base up or down as indicated, are inserted in the trial frame and the test repeated until fusion in either position is equally well achieved, or separation is equal in the two positions. As a rough guide, it may be assumed that a patient can take care of his uncorrected hyperphoria if, from the state of vertical orthophoria created by a supplementary prism, he can recover fusion in each direction when the prism in the handle mount is twice the power of the supplementary prism. If equality of separation

is the best result thus obtainable, and especially if fusion recovery in each direction is only possible when the prism in the handled mount is weaker than the supplementary prism, prismatic spectacles are essential to comfortable binocular vision.*

It is not always possible to achieve a comfortable compromise of prism strength in a case of paralytic vertical diplopia, but it is worth a trial and is successful more often than might be expected. This applies especially to cases due to fracture of the maxilla even when the separation of images is pronounced. Those troublesome defects of eye movement, temporary or permanent, which follow spinal anaesthesia or head injury can often be relieved in this way.

(5) *Subjective Cover Test.*—Miss Margaret Dobson, in this journal (Vol. XXV, No. 2, February, 1941, page 67), describes an objective form of cover test involving polarised red-free light. It is somewhat complicated in application and only grosser amounts of distance heterophoria, amounting almost to heterotropia, can be detected with certainty. Any reasonably intelligent patient, however, can describe the direction in which distant objects appear to "jump," up or down, to right or left, if the examiner covers each eye in turn for one second, passing quickly from one to the other.

(6) *Near-Point Euphoropsia.*—The use of a Maddox Wing Test or some equivalent in the assessment of comfortable binocular vision at reading or working distance is sufficiently common-place to need no urging. The author would like to reiterate the importance of near point esophoria as a cause of frontal headache often situated at the root of the nose, and to advocate as a practical measure of relief in these cases the prescription of such "presbyopic" correction for close work as will establish ortho-, or slight exo-phoria, even in young patients, if the lens power so required does not approximate the punctum remotum and the punctum proximum too closely to each other or to the patient for his convenience. Thus, a man of forty may need the help of spectacles for near work though he can glibly read Jaeger 1, whereas another aged 50, still exophoric by nature at the "near-point," may boast of his ability to read for hours in comfort without glasses, merely cursing the newspapers for being so badly printed in recent years.

Some degree of exophoria at the near point, as measured by Wing Test or convergiometer, is a source of comfort. This amount

* As a standard, a two-dioptre prism should be used in the handled mount. It may be changed for a weaker or stronger one as judgment dictates in any special case. The handled mount was made for me by Messrs. C. W. Dixey some fifteen years ago for a different purpose; a minus cylinder of any power—depending on the visual acuity of the eye under test—can be inserted at 45° to the handle and used as a preferable alternative to a cross cylinder.

has been variously estimated at between two and six prism dioptres. *Greater amounts than this do not necessarily imply* deficient convergence; in the absence of good convergence power symptoms of discomfort may, however, arise. (The author, in hypermetropic enjoyment of full binocular vision, is not inconvenienced by sixteen dioptres of near point exophoria, with one dioptre of hyperphoria.)

Little attempt is made here to indicate the use to which an examiner may put the information obtained. Familiarity with the language and customs of strangers gives mutual benefit by dispelling distrust and misunderstanding; with a wider knowledge of euphoropsia and the factors that disturb it, an ophthalomogist will make his own judgment, critical and reasoned, of the relative values of prismatic spectacles, prism exercises, and the services of the trained orthoptist. All these have suffered some unwarranted neglect in the past from a fear which is bred out of ignorance by suspicion. It is the misfortune of orthoptists to have been associated primarily with the training of squinting children. The spectacular successes sometimes achieved in suitable cases led at first to indiscriminate reference of unsuitable ones, and inevitable disappointment. We do not yet sufficiently appreciate the extent to which they can help *selected* adult patients by " eye exercises " of the right kind.

TRANSIENT SLIT-LAMP APPEARANCES DUE TO CONCUSSION BY SMALL PARTICLES*

BY

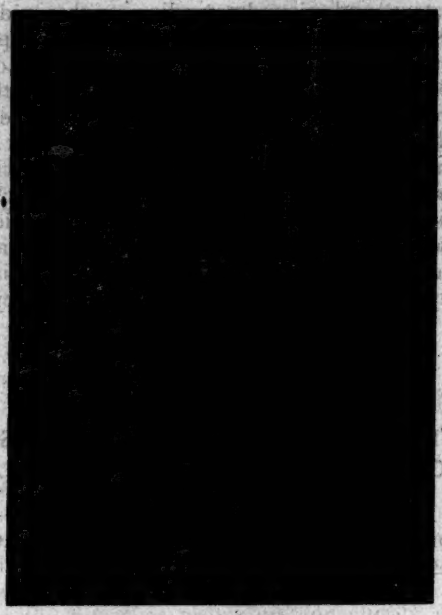
Major D. D. STENHOUSE STEWART, R.A.M.C. *and*
Major J. P. F. LLOYD, R.A.M.C.

WHEN a " back-fire " occurs from the breech of a service rifle, a part of the exploding gases escapes backwards conveying with it very small particles of foreign matter, mainly fragments of incompletely burnt charge. These impinge upon the right side of the face of the soldier firing the rifle; though the force is considerable, the depth of penetration of skin, conjunctiva, or cornea, is slight owing to the small mass of each particle.

A soldier received an injury of this kind at about two o'clock one afternoon. He was admitted to a Military Hospital the same evening. His face and eye were cleaned superficially, and he was examined more thoroughly the following morning. By slit-lamp microscopy multiple minute foreign bodies of various sizes were

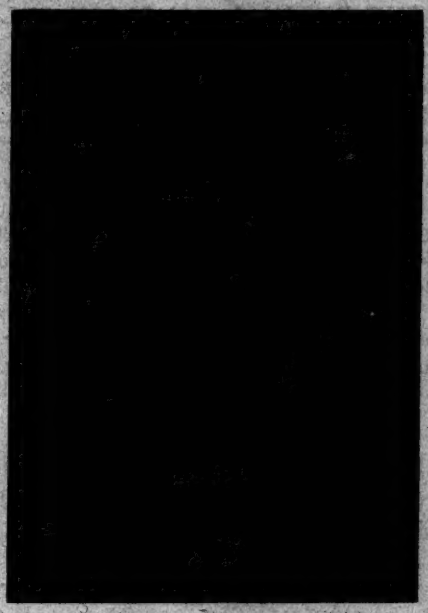
* Received for publication, July 5, 1943.

seen very superficially embedded in the right cornea, and there were many scattered areas of endothelial bedewing. A feature of unusual interest was the appearance at the Descemeto-endothelial level, of minute grey plaques disposed somewhat in the manner of the leaves of a formal laurel wreath, the central area being clear. The plaques of which the wreath was formed gave the appearance of a greyish-white substance (? oedema) distributed around the



endothelial cells in the same location as the pigment of a Krukenburg's spindle. With few peripheral exceptions, these "wreaths" were circular and of an average diameter of about 2 mm., some slightly larger, some a little less, a superficial foreign body being seen to correspond to the centre of each wreath. The wreaths did not intersect and were not cotangential in any instance. The phenomenon was still present 30 hours after the injury, but no trace could be found 15 hours later.

The more superficial foreign bodies were subsequently removed, several minute deep ones being left as their removal would cause more damage than is likely to arise from their retention. The eye was entirely quiet a week after the injury, the man's visual



acuity then, as formerly, being E.E. unaided 6/36; with glasses 6/6.

It is suggested that the grey flecks of which the " wreaths " are constituted (like those transient superficial epithelial grey marks seen in association with a bland conjunctival foreign body) are optical effects from local variation of index of refraction.

The disturbance giving rise to the change in this case is interpreted as the production of general internal stresses in the cornea by the pressure of the exploded gases, to which is added a spherical concussion wave of some definite frequency (possibly of high intensity though brief duration) radiating from the point of impact of each foreign body. It is believed that these " wreaths " of almost uniform diameter could arise from maximum disturbance at the antinode of a spherical concussion wave of this kind, superimposed on the general internal corneal stress.

SENILE AND OTHER PIGMENTARY CHANGES IN THE RETINAL GANGLION CELLS*†

BY

ARNOLD LOEWENSTEIN *and* IAN S. MCGREGOR

FROM THE TENNENT INSTITUTE OF OPHTHALMOLOGY, GLASGOW UNIVERSITY (PROFESSOR W. J. B. RIDDELL)

WE know that the retinal ganglion cells vary very much in size, shape and structure. Near the macula they are small (8-10μ) and form 6-8 layers. In the periphery they are large (30-35μ) forming one layer only, with considerable cell-free intervals. We have not been able to find any retinal area in which cells of an intermediate size predominate. Between the ganglion cells, glial and amacrine cells can frequently be seen.

By our routine methods of fixation and staining, no pigmentary changes have been discovered in the ganglion cells. One of us

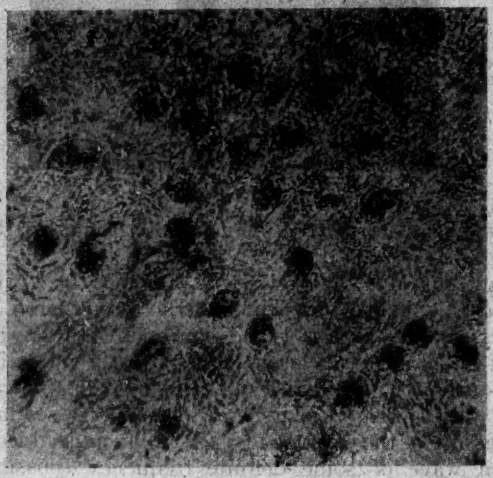


FIG 1.

Senile retina in bulk—normal retinal condition, male, aged 78 years. Stained scarlet red. ×300. Periphery about 10μ under retinal surface. Fatty droplets fill the cell plasma—fatty retinal ganglion cells very dense.

has used the method of staining the retina in bulk with Scharlach Red for a few years (Loewenstein 1942). He found regularly, fatty changes in the ganglion cells in hypertensive and diabetic

* Received for publication, May 20, 1943. † The coloured figures are reproduced in black and white owing to wartime restrictions.

retinopathy. The question arose as to whether or not the droplet staining with scarlet red was really pathological or just a senile change. Accordingly we made an investigation of fatty changes in the ganglion cells in normal eyes of different age groups and in various diseased conditions.

The ganglion cells of the middle-aged and aged show the fatty droplets of lipoid staining in the plasma (Fig. 1). In children

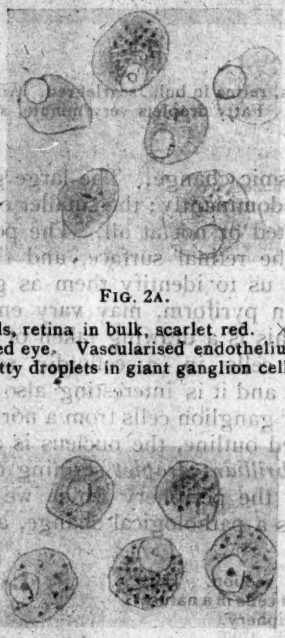


FIG. 2A.

Giant ganglion cells, retina in bulk, scarlet red. ×600. Child, aged 6 years, traumatized eye. Vascularised endothelium with individual fatty droplets. Fatty droplets in giant ganglion cells much rarer than in senile ones.

FIG 2B.

Man, aged 72 years. ×600. Fatty red droplets within the plasma of the ganglion cells. Diffuse brown staining. Retina in bulk—scarlet red.

these changes are absent for the most part but they do occur; we found scanty droplet change in a few cells in the retinal periphery of a child aged six years (Fig. 2a). They are shining red droplets (Fig. 2b). They are sometimes so small as to be scarcely discernible with (×600) power, or so gross that they make the cells stand out in the field with low power. The whole plasma may be full of them. Usually the territory of the nucleus is droplet free, though the nucleus' border may be overlapped by them.

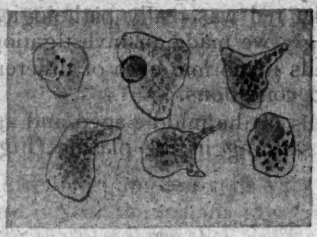


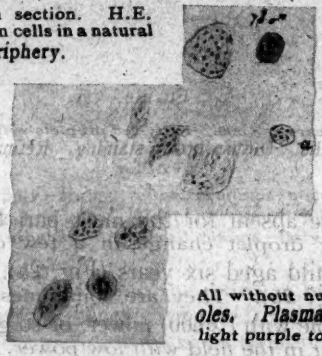
FIG. 3.

Man, aged 72 years, retina in bulk, scarlet red. About 2mm. from the disc. 5/oil, ×675. Fatty droplets very minute, slight yellow-brown staining of plasma.

They are a cytoplasmic change. The large ganglion cells of the periphery suffer predominantly; the smaller central ganglion cells are much less affected or not at all. The position of these cells is (10-20μ) below the retinal surface, and this fact, along with their shape, allows us to identify them as ganglion cells. The shape, though often pyriform, may vary enormously as can be seen in Fig. 3. This is a drawing taken of one field and not of selected ganglion cells in a celloidin section stained with haematoxylin-eosin and it is interesting also to note that in every one of this group of ganglion cells from a normal retinal periphery showing such varied outline, the nucleus is absent (Fig. 3a).

Apart from the *brilliant droplet* staining of the ganglion cells with scarlet red in the periphery which we have found to be a senescent as well as a pathological change, a striking appearance

Retinal celloidin section. H.E. ×1350. Ganglion cells in a natural group, retinal periphery.

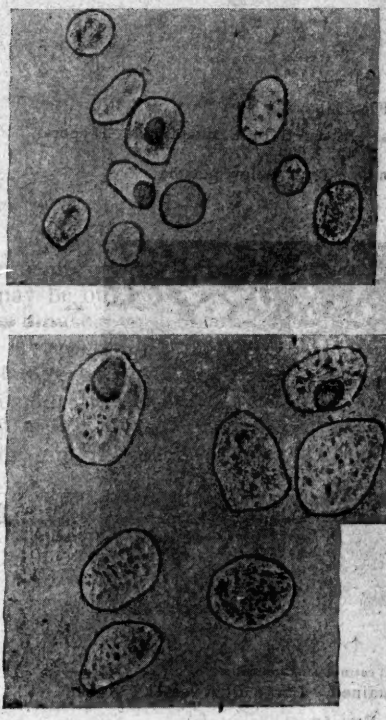


All without nucleus, no vacuoles. Plasma stained from light purple to dark blue.

a=In comparison a cell of the inner nuclear layer.

FIG. 3A.

was noted. The plasma of the ganglion cells of the periphery in senile retinae stained with scarlet red had frequently a brownish, or brownish-yellow appearance. The pigment was limited to the large types but they were not uniformly affected. The presence of pigment may coincide with fatty droplet change or it may not (Figs. 1-4). We failed to see this pigment in sections cut after



Retina in bulk, stained scarlet red. ×300.

a: macular region, cells smaller, some contain the diffuse yellow-brown pigment, most of them fatty droplets.

b: bigger ganglion cells of periphery. All fatty with more or less brown diffuse pigment. Mostly nucleus not visible.

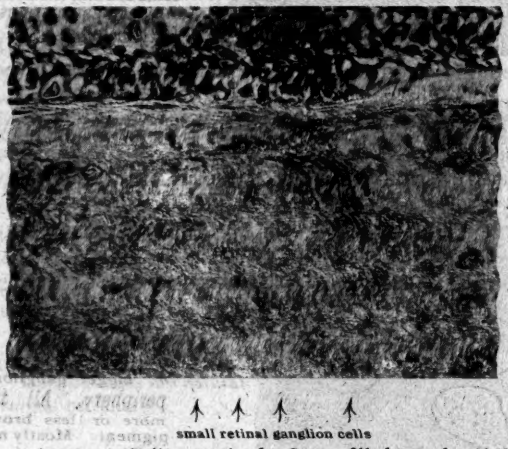
FIG. 4.

paraffin or celloidin embedding but we found it in sections cut on the flat, after processes which do not remove the fat as in gelatine embedding and frozen sections. But it is best detected by examination of the retina in bulk.

Our next thought was to elucidate if possible the nature of this yellowish-brown diffuse pigment which appeared in most of the large ganglion cells in sections stained with scarlet red. Consequently, we examined the unstained retina to exclude scarlet red as a source of the pigment. The retina was cleared in glycerin

FIG. 5A.

Unstained yellow ganglion cells. Retina in bulk, unstained. Hypertension. No retinal changes. 10/40, X600.
n: normal ganglion cells, y: yellow plasma.

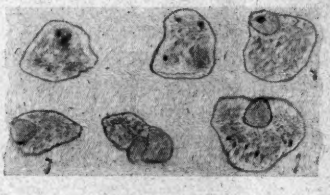


Normal retina in bulk, unstained. Large filled vessel. X600.

FIG. 5B.

and then examined in dim light by greatly reducing the iris diaphragm. There was a yellow coloration of many of the large ganglion cells (Fig. 5a). Yellow ganglion cells and normal ones occur in the same area (Fig. 6). The protoplasm is granular (Fig. 5b). The granular appearance may be due to droplet formation in cytoplasm made manifest by scarlet red; but of this assumption we have no proof. These sulphur-yellow ganglion cells are much less obvious than the fatty ganglion cells of the scarlet red stained preparation with their striking red droplets. We found that after the observer's eye was dark-adapted, the

yellow cells were more easily seen. If the diaphragm is not much cut down they may be missed altogether. We think that this primary yellow colour of the large ganglion cells is modified by scarlet red to give the brownish-yellow colour we have described above. We have found these yellow giant ganglion cells in diabetic and hypertensive retinopathy, glaucoma, iridocyclitis and



Unstained retina in bulk, periphery × 675. Diffuse brownish pigment in some cells. Granular protoplasm.

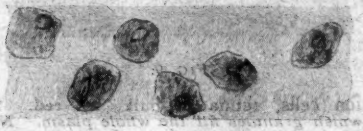
FIG. 6.

in senile retinae. It is to be noted that the yellow ganglion cells may be otherwise normal, or they may have no nucleus, or have an unusual and bizarre shape (Fig. 6).

We were next interested to know whether or not the pigmentary change was limited in normal retinae to the aged. We selected for our investigation, eyes which had been removed early because of injury. In the specimen of a child of six years we found that the ganglion cells had a clearly defined nucleus and nucleolus,

Giant ganglion cells, child, aged 6 years, retina in bulk, unstained. ×600. Nucleus: sharply defined, darker bluish nucleolus, honeycomb pattern in plasma.

Unstained. ×600. Man, aged 72 years, symmetric retinal distance.



Senile cells: Nuclei less sharply defined smaller, often deformed. Often no nucleoli. Plasma darker, more granular, slightly sulphur-yellow. There are normal giant ganglion cells too.

FIG. 7.

this latter being about 1/10 of the diameter of the nucleus. We never saw the yellow pigmented ganglion cells in young retinae. In the child of six years, however, an occasional large ganglion cell showed a few fatty droplets with scarlet red. By comparison then, the aged retina showed ganglion cells in which the nucleus was frequently indistinct, or was absent altogether (Fig. 7). Fatty

FIG. 8.

Hypertensive retinopathy with bilateral sub-retinal exudate. Retina in bulk. Sc. red. 5/40. ×300. Retinal periphery nerve fibre pattern. Brown ganglion cells with fine fatty droplets within the spaces of the pattern. Normal ganglion cells clear between them. Some fatty droplets very minute within the fibres of the pattern.

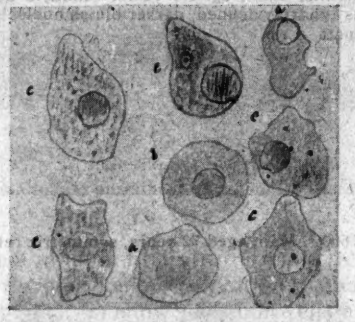
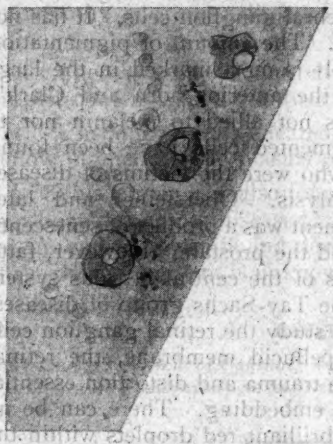


FIG. 9.

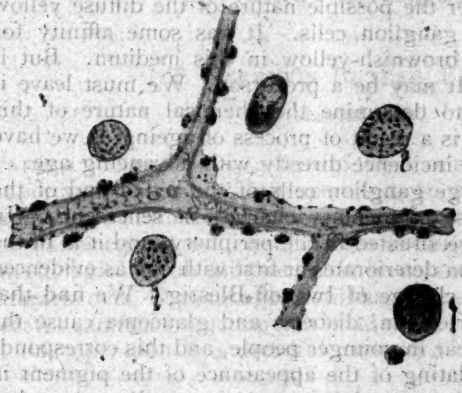
Brown ganglion cells, retina in bulk, sc. red. 10/oil, ×1350. Yellowish-brownish granules fill the whole plasm. Nucleus big (no nucleolus), slightly bluish, no nuclear structure. Some sharp fatty droplets (combined from several fields).
Diabetes without retinal changes
a: normal ganglion cell. *b*: clear brown without fatty droplets. *c*: brown ganglion cells with few fatty droplets.

droplet change in the plasma of the giant ganglion cells was a constant feature. We have found fatty ganglion cells in the retinal periphery especially of hypertensive retinopathy (Fig. 8). Here they stand out sharply between the smaller normal ganglion cells without fatty droplets. They are all surrounded by the deep arcuate optic nerve fibres. They are very frequent also in diabetic retinopathy. Fig. 9 shows large ganglion cells with very few fatty droplets, brown ganglion cells without red droplets and giant



Diab. ret. pathy, stained retina in bulk, sc. red, embedded in gelatine, cut flat, not afterstained. ×600. Three giant brownish-yellow ganglion cells (compare with retina in bulk), one only has 2 fine fatty droplets. Mueller fibres contain rows of fatty droplets.

FIG. 10.



f: big fatty ganglion cells with and without diffuse brown pigment.

g: small fat phagocyting cells along vessel walls.

o: an obliterated venous branch.

FIG. 11.

Iridocyclitis, glaucoma sec. absol. retina in bulk, scarlet red. ×300.

ganglion cells without droplets or diffuse brown staining. Lipoid change was also found in Müller's fibres as we could prove in our gelatine embedded sections of retina stained in bulk with scarlet red, cut with the freezing microtome and studied without nuclear staining (Fig. 10). Fat phagocytizing smaller cells very often accompany vessels. They belong to the microglia (Rio Hortega) (Fig. 11).

Discussion

Obersteiner (quoted by Spielmeyer) has written on many occasions of the clear yellow pigment in cerebral ganglion cells. It has not been seen before the seventh year. The amount of pigmentation of the cells increases with age. It is most marked in the large ganglion cells such as those of the anterior horn and Clark's column. He thought that it was not allied to melanin nor to blood pigment. The yellow pigmented cells have been found by Obersteiner in young people who were the victims of diseases like dementia praecox and paralysis. Obersteiner and later Lubarsch, concluded that this pigment was a product of senescence like that found in heart muscle and the prostate. However, fatty degeneration of the ganglion cells of the central nervous system occurs as the essential lesion in the Tay-Sachs group of diseases.

We are fortunate in that we can study the retinal ganglion cells so much more easily in a thin pellucid membrane, the retina, which can be mounted without the trauma and distortion essential to long processes of fixation and embedding. There can be no doubt of the lipoid nature of the brilliant red droplets within the plasma of the ganglion cells. The scarlet red reaction can now be regarded as the most reliable stain for fat. But argument arises when we consider the possible nature of the diffuse yellow pigment of the large ganglion cells. It has some affinity for scarlet red, becoming brownish-yellow in this medium. But it is not a true lipoid. It may be a precursor. We must leave it to later investigators to determine the chemical nature of this pigment. Certainly it is a result of process of ageing as we have found it to increase in incidence directly with advancing age.

Finally, it is the large ganglion cells of the retina and of the brain which show these pigmentary changes of senescence. In the retina these cells are situated in the periphery, and it is in the periphery that the retina deteriorates at first with age as evidenced by the frequent cystic change of Iwanoff-Blessig. We find that diseases such as hypertension, diabetes and glaucoma cause the yellow pigment to appear in younger people, and this corresponds with the similar ante-dating of the appearance of the pigment in the ganglion cells of the central nervous system where there has been organic nervous disease.

Summary

1. Using the method of examining the retina in bulk unstained and stained with scarlet red, we found that the ganglion cells of the retinal periphery showed fatty droplets in their plasma in diabetic, hypertensive, and other diseased conditions, and in the senile retina. The retinal glial cells contained fatty droplets in these conditions also.

2. The plasma of the large ganglion cells stained diffusely brownish-yellow with scarlet red in hypertensive and diabetic retinopathy and other diseased conditions, and also in the senile retina.

3. There was no quantitative relationship between the fatty droplet content and the diffuse brownish-yellow staining.

4. Unstained retina cleared in glycerine revealed a sulphur-yellow pigment in the plasma of the ganglion cells in old age.

5. This pigment is also found in the retinae of younger people in whom the eye is diseased, and is analogous to that found in cerebral tissue in senile and diseased brains. The chemical nature of the diffuse pigment is unknown but it may be a lipoid precursor.

REFERENCES

LOEWENSTEIN.—*Arch. of Ophthal.*, Vol. XXVII, p. 73. 1942.
SPIELMEYER.—Histopathologie des Nervensystems, Springer, 1922.

CATARACT EXTRACTION*

BY

T. HARRISON BUTLER, F.R.C.S.

BIRMINGHAM

CATARACT extraction is a fearful joy: one of the most difficult, important, and interesting operations in surgery. Extraction is unique in that not only is a high degree of technical skill required for its successful achievement, but because each case presents a psychological problem that must be solved. I began to extract cataracts over 40 years ago, I still have the same if not greater respect for cataract extraction that I had when I faced my first. To fail in this operation is a dreadful calamity. The patient may have

* A Lecture given during the Course for the Diploma of Ophthalmology at The University of Oxford on May 18, 1943. Received for publication, June 1, 1943.

been blind for some time, he has month after month looked forward to receiving his sight back; he nerves himself for the operation: he leaves the hospital blind, and this time if he has only one eye, bereft of hope: blind for life. This is a shocking prospect, and it behoves us to strain every nerve to prevent such a catastrophe. It is comparatively easy to succeed in a few operations, but difficult to obtain a good series. I wish to consider in the light of my own experience how to avoid failure, and to obtain a high percentage of useful visual acuity after operation. We must deal with: first the surgeon himself, then the nursing staff, the operative environment, and finally the patient.

The Surgeon. Poeta nascitur non fit: "Some men are born great; some achieve greatness: and some have, alas! greatness thrust upon them.

The Born Operator.—There is no doubt that a few men have a natural gift for ophthalmic operating. Once, at the Coventry Hospital, I had a house surgeon of this type. He was not wholly an ophthalmic house surgeon; I shared with him the medical side, one of the house physicians. He assisted me for a short time, and then I gave him an iridectomy, and was amazed that he performed it as though he had been doing eye operations all his life. He was an extraordinarily able man and a fine general surgeon both in knowledge and operating. When a man of this type takes the trouble to perfect himself in every way he can become one of the world's great operators. Such natural gifts are given to few; most of us with more or less ability have to achieve greatness. There are a few, those who have greatness thrust upon them, who have no natural gifts; they have never learnt to use their hands, and are quite out of place as ophthalmic surgeons. How can we achieve success, become reasonably safe operators? This is a most important question and calls for a careful study. Let us first consider what are the chief qualities necessary. Good sight and perfect stereoscopic vision are essential. A man with an amblyopic eye, or defective acuity ought never to take up ophthalmology. Then the eye surgeon needs "Good Hands." He ought to have good health, and steady nerves. The temperamental neurotic surgeon should avoid this sphere of surgery. A shaky trembling hand is a handicap, although the late William Lang was a marked exception. His hands were tremulous but the moment the operation began they become perfectly steady and his work was a joy to behold. Finally the ophthalmic surgeon must be a psychologist, able to inspire confidence in his patients. The education of the ophthalmic surgeon must begin early. No one should learn any kind of surgery upon the patient. The hands ought to be trained early. Every medical man ought to begin with some form of handiwork, chip-carving for the otologist, and carpentering for

the general surgeon. Later on in the early medical courses there should be more zoological dissection, especially under the dissecting microscope. Piano-playing is excellent for training the fingers for eye operating, but stringed instruments should be avoided. To play the violin properly hours must be spent in developing a tremor of the wrist, the very worst thing possible for a surgeon. All forms of drawing are excellent. I find that I operate best when I have been drawing the day before. Medical students ought to have to pass an examination in drawing. Since I have been examining for the Diploma in Ophthalmology at Oxford I have been surprised by the low standard of the diagrams sent in. So much for the hands. The general training of the surgeon is quite as important. A cataract operation is a tense trial of the senses. A general surgeon may begin by being nervous, but he has plenty of time to settle down and forget all about his nerves. Not so the cataract extractor. The whole thing is concentrated into a few moments. A bad section is a bad operation, *l'extraction c'est la section* in the words of a well known French oculist. We must keep fit, avoid alcohol, and excessive smoking, get to bed early, and get as much fresh air as possible. Finally avoid any heavy muscular work just before operating, for such favours trèmour. Many years ago I read the advice of an Indian surgeon to the oculist. He suggested that he ought to have an injection of morphia before operating. A man whose nerves require such treatment ought not to operate at all. To be a really good cataract extractor one ought to do many operations. The man who does one operation a week or even less can never attain the dexterity of one who does one or more a day. The Continental plan, when one man is Director of the Hospital and does as many operations as he wishes, is far better for the patient. The whole thing becomes automatic and as near perfection as possible. Skilled nursing is essential if good results are to be obtained, and here again the nurse is born, not made. At the present moment I am doing most of my operating in an E.M.S. Hospital. The nurse who assists me in the operations does not *assist*, she gives me four hands. Her fingers are always in the right place at the right time, and if I am about to do anything wrong she corrects me at once. And yet she has no State Certificate but merely a training at a Home for Incurables. Most of the rest of the staff are V.A.D.s, but I have yet to find their equal in efficiency.

The *environment* is most important. A good eye hospital, or, better a good eye department in a General Hospital is of course the best. The very worst is a bad eye department in a small General Hospital where there is no proper eye-ward, and no skilled ophthalmic nursing. Most fatal of all is when the eye patients

are in a general surgical ward. During the first eight years of my work at the Warneford Hospital, Leamington, seven per cent. of my extractions were lost being in a surgical ward. When the eye cases were removed to a medical ward, and all the globe operations placed in a side-ward, I did not lose a single eye in twelve years. My experience at the West Bromwich Hospital has been similar. It comes to this: with the best nursing you cannot get good results if the eye cases are in the same ward with general surgical cases. I do not like nursing homes where the operations are done on the same table that is used for surgical patients. The previous case may have been an extravasation of urine or a septic appendix, and the nurse who dresses a cataract may have been dressing a foul burn. Septic fingers remain septic for a long time in spite of disinfection. For this reason the eye surgeon must never handle anything septic. Far better to do the operation at the patient's home where there is no likelihood of sepsis. I have never had a case go wrong that was done under such conditions.

The Preparation of the Patient.—The most important preparation is psychological. The patient must be put upon the table in an equable and happy frame of mind, free from fear, and confident of a happy outcome of his operation. This psychic training depends largely upon the nursing staff and on the ophthalmic atmosphere of the ward. A sensible sister will have an enormous influence upon the moral outlook of the patient, and conversation with other patients who have undergone operation, especially with children, will inspire confidence. If the patient, instead of being happily housed in a quiet ophthalmic ward or in his own home, is placed in a surgical ward, he cannot be expected to be in the right frame of mind to undergo his own operation.

The actual physical preparation of the patient is quite simple; in fact, the simpler the better. He must be thoroughly examined for any foci of sepsis, special attention being given to the teeth. The lacrymal sacs should be irrigated a few days before the operation, not on the day before, for if there are any septic organisms in the sac they may be washed out into the conjunctival sac and lie ready to infect the wound. A culture ought to be taken 48 hours or more before operation, for medico-legal reasons if for no other. I am a little sceptical of the value of the ordinary bacteriological examination. There are far too many sterile cultures. Mr. Browning, the bacteriologist at Moorfields, told me that in his opinion a sterile culture means a faulty technique. In practice I have found that a clean culture is not a safeguard against infection, for every case of pan-ophthalmitis that I have had has been sterile.

There need be no local treatment of the eye. The tears contain

their own antiseptic, lysozyme, and any irritating lotion causes lacrymation, and reduces its amount. I like to have the eyes washed out with normal saline just before the operation, and with nothing else.

The only general treatment is to have the bowels properly emptied so that there need be no evacuations for a day or two after the extraction. No purgatives should be given the day before. If they are necessary they should be used two days before. Free purgation is wrong; a fluid stool is a toxic stool, weakening the patient both by dehydration and by poisoning. If the bowels have not acted properly the day before operation, enemata must be given. If a preliminary iridectomy is to be done, eserine must be used with the cocaine, for it is difficult to perform a neat iridectomy with a dilated pupil. Some surgeons like partially to stupefy their patients with medinal or other narcotics. These drugs may be useful after operation, but I prefer to have my patient dead or alive. I want full co-operation, and feel that the patient ought to be calmed by the psychic powers of the sister and the surgeon, and not by drugs. I always use cocaine as the local anaesthetic, a 2 per cent. solution, a few drops every five minutes, about four instillations being sufficient. If a preliminary iridectomy has been done, the pupil may be dilated with atropine.

The Operation.—In this lecture I am describing my own methods. I have tried others but they have crystallised down to the very old-fashioned operation that was performed at St. Bartholomew's Hospital by Mr. Henry Power and Mr. Vernon when I was a dresser in the ophthalmic wards. I am more than old-fashioned in liking preliminary iridectomy. Most surgeons admit that it is the safest way, and many say that they perform it when the patient has only one eye. Well, he has only two, and I like the safest operation, and so I perform a preliminary iridectomy whenever I can. I advise all beginners to adopt this method, for it is the easiest as well as the safest. There are three main reasons why I adopt preliminary iridectomy. It gives one an indication how the patient will behave at the extraction, and the size of the lens can be estimated in the coloboma. Quite recently I did an iridectomy and it was at once obvious that the patient had no control, and would be a real menace at the extraction. I extracted under pentothal anaesthesia and all went well. Then when one is making the section with an intact iris one has two things to consider: to avoid wounding the iris, and to make the section exactly as designed. If the slightest drop of aqueous is lost the iris tends to float up before the knife, and in trying to avoid it the section may come to lie too far forward, even in the cornea. If there is an iris coloboma the surgeon can devote his whole

attention to the section and neglect the iris. Then before the extraction one can estimate the size of the lens by examination with the slit-lamp because the edge of the lens is visible in the coloboma.

Preliminary Iridectomy.—I use my own keratome which has proved to be the correct size, and I prefer an iris hook to forceps. The grip of the forceps may cause pain, because the iris may not be fully anaesthetised, and the patient may jump. The hook tends to make a smaller and more symmetrical coloboma than the forceps.

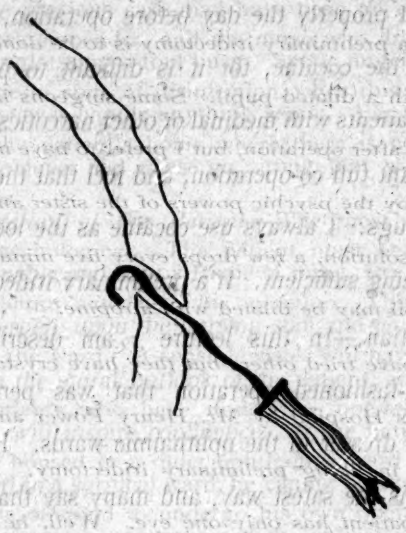


Diagram shewing how the iris hook if not rotated through 180 degrees may catch on the wound spur.

On the other hand it is more dangerous, and I recommend the beginner to use forceps until he is quite proficient. The hook is introduced on the flat and cautiously rotated to engage the pupil margin, great care being taken to avoid any pressure on the lens capsule. Then it is twisted through 180° and drawn out with the short arm of the hook outwards. A consideration of the nature of the section shows that there is a sharp lip on the limbal side, whereas the corneal edge is smooth. This is shown in the diagram. If the hook is rotated there is nothing for it to catch on, otherwise it may catch on to sharp spur of the wound edge. If I have a

really good assistant I let him cut the iris with ordinary angled iris scissors, which are better than the de Wecker type which we use if we cut the iris ourselves. I hold the iris hook and the fixation forceps in the left hand, make the section, hand the keratome to a waiting hand, insert the hook, and the assistant cuts the iris. One never lets go of the eye, and the operation is just one, two, three, four, and it is complete, in under half a minute. No atropine is necessary in the majority of cases, and the patient goes home on the fourth day if there is no injection. He is now satisfied that there is nothing to fear in an ophthalmic operation and faces the final extraction without anxiety. You will be told that this is "an old woman's operation"; well, the war has shown that old women have their uses. Sir Anderson Critchett, who had an enormous experience in extraction, told me shortly before his death that he always did a preliminary iridectomy and thought it by far the best and safest procedure. About a month later we can proceed to the extraction. For this and all other globe operations I always use a projection lamp, and the beam is directed from behind the surgeon so that all reflections are thrown away from the surgeon's eye. Keratomes and the corneal surface are good mirrors, and if the light is employed so that it is reflected back to the operator, he may find that he can see nothing but a glare.

There is a correct way to hold all ophthalmic scissors. The thumb and the ring finger engage the loops of the handles, the index finger rests upon the hinge, and the middle finger rests below the loop upon the ring finger. By this method the hand and scissors become almost one, and the blades are pressed upon each other, so making a clean cut. In most operations the hand is held in the supine position, with the arm close to the side. A little practice with a pair of dressing scissors will make this hand-hold almost automatic.

The Extraction.—The patient must be placed on the table at a convenient height so that the operator's forearm makes a right-angle with the upper arm. The face should lie quite flat. A nurse must take one of the patient's hands and hold it centrally over the chest. Then we do not ask the patient to look down, but say "look at your hand." This is most effective and was I think recommended by Priestley Smith. The patient must, during the actual operation, keep his mouth open, for it is not easy to squeeze the eyes with an open mouth.

Akinesis.—I like my cases to have an injection of novocain and adrenalin half an hour before the operation into both lids and into the temple to anaesthetise the fan-like expansion of the facial nerve. I have never used retro-ocular injections which may cause a large intra-orbital haemorrhage and make the eye soft. Nor

have I ever tried nerve blocking of the facial nerve at the angle of the jaw. It is probably an excellent procedure. If the patient is obviously likely to lose control, some form of general anaesthesia is necessary. I have adopted it in not more than five cases, and I dislike it very much. It is difficult to keep the eye from turning up, but this is helped by a suture under the superior rectus. Then there is always the danger of vomiting after the operation. Post-operative vomiting may occur after local anaesthesia. It is I think due to a too lavish use of cocaine. Only a few drops are necessary at each instillation. If more is used it passes into the nose, which is a much more efficient absorber of cocaine than the stomach. While the patient is being cocainised the eye should be covered with a pad to avoid desiccation, and exfoliation of the corneal epithelium.

The face and mouth must be covered with a bit of gauze. It is best cut from a six-inch cotton bandage. There will be an adequate hole for the eye and another for the nose so that the patient may not get the idea that he cannot breathe. We now insert the speculum and proceed to the section. The surgeon must remember that he has two hands to think about. He must not, in his anxiety to make a good section, forget his fixation hand. He may unwittingly make considerable pressure with these forceps instead of drawing the eye gently forwards. I notice that the beginner is very apt to fall into this trap. No one ought to perform his early extractions except in the presence of an experienced operator. I always tell my house surgeons that they must be prepared to hand over the operation to me if I think it necessary. He may have made a bad section and then it needs a good operator to overcome this initial fault, and there are other difficulties which experience can overcome. Naturally he will have practised with the phantom, using both hands. I remember that Mr. Power used to advise us, if we intended to take up eye surgery, to shave with the left hand. I followed out this advice, although at that time I had no idea that I should one day have to operate upon eyes. After trying many knives I think that the best is the so-called Smith's knife. This has a straight back so that the line of the section lies exactly in front of the knife. The Graefe knife has a bulge behind the line of the back and tends to push the corneal tissue without cutting it. Also the Smith has a more acute-angled point than the other type, and is therefore sharper. Another good knife is the Lindsay Rea, but I think that this is a little too short to get a good sweep and avoid sawing. The knife must be as sharp as the maker can achieve; a really good one will make a large number of sections. I dry the knives myself and strop them on the towel as I do so. It is not a bad plan to have a bowl of boiling oil and dip the knife into it before making the section. The section

must be made with the fingers and not with the arm. Grasp the handle well away from the blade as possible; do not hold it short, otherwise there is no room to make the full sweep with the fingers. The knife is held by the thumb and the first and middle fingers like a pencil, the little finger rests upon the patient's face. You will now see why I have advised you to practise drawing. It is essential to make an adequate section; a small section leads to all kinds of complications. Enter the point of the knife at a spot about two-fifths of the vertical diameter from the top and, being careful not to twist, pass it slowly across the anterior chamber. There is at this stage no need for any hurry; there will be no loss of aqueous if the knife is not twisted. A twist has two disadvantages: aqueous will be lost, and the iris will rise up before the knife, and the knife may jamb, and great difficulty will be experienced in freeing it. The knife must be passed across perfectly horizontally or it will emerge too high or two low. The second fault means a danger of wounding the ciliary body, with great haemorrhage. A superficial exit means a corneal section which may be too small. The moment the point of the knife appears, do not lose a moment, but carry on the section with a sweeping movement, letting the handle of the knife move towards the patient's chin. The section must be a clean sweep, cutting upwards all the time—a drawing, not a sawing motion. It is sometimes possible to complete the section with this initial sweep, but generally it is ended with the withdrawing action of the knife, *in and out, cutting every fraction of the time.*, The conjunctival flap may call for a few sawing movements. I like a medium-sized conjunctival flap. Now gently remove the speculum and perform the capsulotomy, either with capsule forceps or with the capsulotome. I prefer the kind that has a sharp spike at right-angles to the shaft. I enter it at the lower end of the vertical diameter and draw it upwards, making a central sagittal slit in the capsule. Now take the lens expressor (the glass pattern is the nicest) in the thumb and first two fingers of the right hand, again holding it like a pencil or paint brush, and, with the ring finger of the right hand, draw up the upper lid. Take the capsulotome or a lens hook in the left hand and use the left ring finger to depress the lower lid. If you have a really good assistant let him draw down the lower lid. We remove the speculum because it makes squeezing less likely. Now place the expressor on the lower aspect of the cornea and make backward pressure gently, displacing the lower edge of the lens backwards and upwards. The upper edge will now appear in the wound tilting slightly forwards. The next action is to insert the capsulotome spike into the back of the lens and deliberately to draw it out, making slight pressure the while with the expressor. It is wrong to *express* the lens; we must

deliver it by *traction*. The most important factor is extreme gentleness. Avoid pressure, which may lead to loss of vitreous and haemorrhages.

The operation may now be complete. If there are no obvious masses of cortex, and if the pillars of the coloboma are in their correct position, there is nothing more to do. Shut the eye and put on the bandage. If there is visible cortex, gently depress the posterior lip of the wound with a lens spoon, and with the utmost care express as much of the cortex as will come out easily. The rest I leave to absorb. If the patient is obviously dangerous and liable to express the whole contents of his eye at any moment, then I make no attempt to remove the cortex. Some operators wash out the cortex. Many years ago I did this for the first time. I had myself sterilised the normal saline and all the apparatus. Everything seemed to be normal and I had had a sterile culture, but the eye developed pan-ophthalmitis on the third day and had to be removed. Since then I have viewed washing out with some misgiving, and wonder whether it has the same effect upon the eye as upon the peritoneum. In the old days surgeons washed out the whole of the abdomen after a laparotomy with normal saline, and in spite of careful asepsis many patients died of peritonitis. We may be removing some substance that is inimical to the growth of organisms. I think that the less the interior of the eye is interfered with the better. Never introduce two instruments if one will do. For this reason, if the surgeon is sufficiently expert, it is a good thing to rupture the capsule with the knife during the section.

Difficulties in Delivery.—If gentle pressure of the right kind in the right direction fails to make the lens present, on no account try a little more pressure; that way lies danger. Perhaps the capsule has not been ruptured. Try again with capsulotome or forceps or both. If this fails, then it is almost certain that the section is too small, either because the surgeon has made it too small or because the lens is abnormally big. Enlarge the section on each side with angled iris scissors. Now make another attempt. Generally the lens will present. If it fails to appear, there may be a shrunken vitreous behind it, what my colleague at Jerusalem, Mr. Edmund Cant, used to call an absence of *vis-a-tergo*. Do not attempt to remove the lens by extra pressure; remove it with the vectis. Under normal conditions this can generally be accomplished with little or no loss of vitreous. The vectis must be thrust vertically downwards past the edge of the lens and then lifted under the lens so as to draw the lens forward towards the centre of the cornea. Then, always maintaining this forward pressure so that the lens cannot escape from the vectis, it is gently drawn out. Never forget that, come what may, you have to extract the

lens; if not, you extract the eye later on. Only twice in perhaps something near 1,000 extractions have I failed to remove the lens, and in each case the eye was removed. In one example the other eye was lost from an inflammation arising four months later, which may or may not have been of the sympathetic type.

Loss of Vitreous.—This may occur at any time during the operation, and is due to one or more of three causes: the operator may have been clumsy or inexperienced; the patient has strained; or, finally, a sub-choroidal haemorrhage may have caused a detachment of the choroid, thus thrusting out vitreous. I think that this last cause has not received the merit it deserves. It is obvious that if the choroid detaches, and the detachment is often quite large, it takes up space in the globe, and that therefore vitreous must seep out. I am not alluding to that dreadful calamity, expulsive haemorrhage. I have lost vitreous after a perfect section, when the patient did not make a movement of any kind. The section was made and vitreous appeared between the lips of the wound. If this happens, at once take up the vectis and remove the lens. Probably you will lose very little vitreous. If you have done a preliminary iridectomy, at once put on the bandage. If not, and if the patient is quite quiet, perform iridectomy. If the pupil has become round, you may leave well alone; but if the iris is impacted in the wound, you must remove it if you can. I am now considering that mild form of loss which is associated with choroidal detachment. The common form of loss is caused by the patient straining after the lens has been extracted. It may happen while you are merely looking at the eye to see whether you have to perform an iris toilet or extract cortex, but it generally comes with the lens, and may be massive. The patient is now out of hand, and by far the best thing is to close the eye at once, and not to open it again for about four days. If the iris is impacted it can be dealt with now under a general anaesthetic, pentothal for choice. Any attempt to replace the iris at the time of the operation will be followed by more and more loss. My statistics show that practically all the complications of a cataract operation are twice as frequent after loss of vitreous than after a normal extraction. Nevertheless, in general we obtain a good result, but the visual acuity that follows is not usually as good as it is when no vitreous has been lost.

Collapse of the Cornea is not uncommon, and I welcome it, for one never has the fear of vitreous loss in these cases. On the other hand, I think that the removal of the lens may be more difficult, for those patients who get collapse of the cornea may also have a shrunken vitreous and an absence of that *vis-a-tergo* that is so necessary for delivery.

After Cataract and Discission.—The latter word is an anachronism, for it means tearing apart, and no modern surgeon tears when he can cut. The discission needle is now a museum piece, and I imagine that a small knife of the Ziegler type has taken its place. It is better to use the word capsulotomy and let discission die a natural death. This operation is necessary if adequate vision has not been gained by the extraction. The age of the patient, his work, and his own feelings on the subject must all be taken into account, and also the results of the surgeon's own objective examination with the ophthalmoscope and slit-lamp. If the patient has 6/18 acuity and is satisfied with this, leave well alone. It is a golden rule in surgery never to perform any operation that can be avoided. In my own practice I find that I have done capsulotomy in 25 per cent. of my cases. Others I know perform it far more frequently—some, I am told, in almost every case. It is said that in most cases the capsule becomes thickened or crinkled, and that if this happens some years after the first operation, capsulotomy is apt to be difficult and unsatisfactory. This in general has not been my own experience. If the operation is necessary, it should be done within a month of the extraction if the eye is free from inflammation. At this time the zonule is still maintaining some tension upon the capsule, and if we make a vertical incision into it, the wound gapes, leaving a nice oval aperture in the capsule. Later on this does not happen, and the procedure is apt to be difficult, and it may be necessary to repeat it. The knife must not be introduced through the clear cornea, but through the limbus. Statistics have shown that a corneal section is far more likely to cause infection of the eye; I think in one paper that I read it was placed at ten times more dangerous. I have never had an infection from a limbal capsulotomy, but I can recollect three after a corneal operation.

Infection.—This may take the form of a pan-ophthalmitis or of a slowly developing irido-cyclitis. The first form was in the past always fatal to the eye, but since the introduction of the sulphonamides it is slightly less deadly. I have, during the past four years, saved three cases by the use of sulphanilamide (prontosil). In the last case capsulotomy was performed after an extraction that had not caused the slightest trouble. An abscess formed in the vitreous and I could see a track of pus from the limbal puncture to the vitreous. We pushed prontosil and M. & B. and the eye made a perfect recovery with an acuity of 6/12.

Maturity.—The old idea that one ought not to extract till the cataract is complete, judged by the fact that the iris no longer throws a shadow upon the lens, is still not dead, and patients are even to-day made to wait in blindness for a " maturity " that may

never materialise. Some years ago I extracted the lens of a woman aged 94 years. Her anterior chamber was so shallow that I had to begin the section with a broad keratome and enlarge it with scissors. The lens was very soft and there were masses of cortex that had to be removed after the delivery of the small lens nucleus. She did very well and lived for two years enjoying her eye-sight.

Double Cataract.—If one has operated upon one eye in an elderly patient and has obtained a good result, it is I think wise not to tempt providence a second time. Not only is there the risk of failure, but there is a general risk. These old people sometimes begin to go downhill after any operation upon the globe, and some of them become mentally deranged. In my early days I had many of these cases, but during the past twenty years I have had no case of post-operative insanity. In a younger and healthy patient it is quite justifiable to extract the second lens if the patient wishes, but I would never urge him to have a second operation.

Unilateral Cataract.—I never operate upon a cataract in one eye if the other has useful vision. Nearly all these cases suffer from diplopia after the operation, and it may be so distressing that they have to wear an obturator or ground-glass over the better eye. I have seen several examples of this calamity, some in my own practice. It is said that a cataract ought always to be extracted because it may become hypermature. Now hypermaturity is very rare in this country, although I saw several cases in Jerusalem. It is not an end-stage, but a disease of cataract. I have never had any difficulty in dealing with hypermature cataracts, and sometimes they cure themselves.

Refraction after Extraction.—The eye, after extraction, ought always to be examined with Placido's Rings. These will always show gross regular distortion after an extraction. At first the figure will be rhomboidal with the corners rounded off. This will rapidly change to a vertical oval, and it may be some weeks before the rings become circular. The final refraction must be carried out with great care. Often a very small alteration of the angle of the cylinder will greatly increase the acuity obtained. In general, the sum of the sphere and the cylinder is 12 dioptres. Thus, soon after the operation, the eye may take a 6D. sphere with a 6D. cylinder, axis horizontal. Then this changes to 8D. and 4D., and finally to 10 and 2, which is the most common refraction after extraction upon an emetropic eye.

Alternative Methods of Extraction.—I have described the ordinary extraction with iridectomy. This has always been my method of choice, but there are many alternatives.

Simple Extraction.—This method is very fashionable and gives very pleasing results, but it has certain objections. The most important in my mind is that the eye has to be squeezed to bring the lens through the pupil. This is contrary to what I consider to be the fundamental factor in extraction—extreme gentleness and the minimum of pressure on the globe. The iris itself is traumatised, and with the slit-lamp I have seen a series of small ruptures in its pupillary margin. Prolapse of the iris is a common complication and a very serious one. A year ago I performed what I thought to be a perfect simple extraction. When the lens was delivered, the pupil returned to its circular shape almost with a snap. I did a small Hess peripheral iridectomy. When the dressings were removed on the third day there was a large iris prolapse. I excised this, but the anterior chamber did not reform, and the eye gradually went from bad to worse, and had to be removed some months after the extraction. I had a similar experience some thirty years ago at the Coventry Hospital. With an intact pupil it is more difficult to remove the cortex than with a coloboma in the iris. If there is any irido-cyclitis after the operation, the small pupil is more liable to become blocked with exudate than an iris coloboma. What are the advantages? It is said that there is not so great a liability for capsule to become impacted in the wound. The round pupil is, of course, more artistic than the usual key-hole pupil, and it has been claimed that a simple extraction gives better acuity than the combined method. I very much doubt whether this claim can be substantiated. On the whole, I prefer not to perform simple extraction because I consider that the combined method is safer.

Bridge-extraction.—Some twenty years ago I did a series of extractions under a conjunctival bridge. I discarded this operation because it was more difficult to deliver the lens, and more pressure was needed. There was a tendency for the scleral wound not to heal under the bridge because it was bathed by isotonic fluid and the stimulus to healing was absent. On the third day new blood vessels formed and these tended to rupture and fill the anterior chamber with blood. Finally, the pull of the flap caused extreme degrees of astigmatism. I did not think that the flap operation was helpful in avoiding vitreous loss; rather the reverse.

Intra-capsular Operations.—I have performed very few of these and shall most certainly never do any more. There can be no shadow of doubt that this operation is far more dangerous than the operation after capsulotomy. Heavy pressure is needed to extract the lens by Smith's method, and loss of vitreous is common. The whole of the posterior chamber of the eye is laid bare, and the vitreous exposed. This tissue has no resistance to infection. I have recently read some statistics from an Indian Clinic in which

the Indian operation gives superior results to the capsulotomy operation. But the author fails to point out that all the most suitable cases were operated upon by the intra-capsular method, and only the poor chances done with capsulotomy. This fact, of course, vitiates the statistics. Also, it is a very great mistake to think that what is suitable for India is good for home consumption. After operating in Jerusalem, I was most disagreeably surprised when I began in England to find that I was faced with such complications as irido-cyclitis, that I had never seen in Palestine.

DIABETES AND THE EYE

THIS was the subject of discussion at a meeting of the Clinical Society held at the Royal Eye Hospital on July 16, 1943.

Miss Orr-Ewing, the Chairwoman, welcomed the visitors. She said that bricks and mortar might be destroyed; but never the democratic Royal Eye spirit. At these meetings all were equal. The Honoraries had no privileges; but if they took part must stand on their own merits. She thanked Dr. Lawrence, the principal speaker, for his kindness in coming to the meeting. He would be listened to with great attention, and might expect a barrage of questions and possibly criticisms.

Dr. Lawrence said that before describing the changes he had observed in many thousands of diabetic eyes, he proposed to give a brief outline of what the diabetic defective metabolism is and particularly what changes it makes in relation to the physiology of the eye. Normal people had got 100 milligrams per cent. of sugar in their blood in the fasting condition; after a meal containing carbohydrate—sugar, cakes, buns, etc.—the blood sugar rises for an hour or two, but practically never goes above 170 milligrams per cent., from absorption of sugar from the gut into the circulation. When this increased blood sugar reaches the pancreas it stimulates the production of sufficient insulin to burn and store this excess of sugar so that the blood sugar rapidly returns to normal. In diabetes, the production of insulin is defective. the blood sugar rises to 2, 3, or 4 times the normal, sugar spills into the urine and the typical symptoms of diabetes are produced by two main factors—the loss of the nourishing carbohydrate food, and dehydration—which always follows heavy glycosuria. When this loss of sugar becomes very heavy and the insulin production so low that little carbohydrate can be burned, then a secondary disturbance of fat metabolism occurs, known as ketosis — when acetone bodies appear in the urine, cause, and lead through stages of air hunger, vomiting, etc., to death through diabetic coma. During ketosis the intense

polyuria, vomiting, etc., greatly increases the loss of water, and dehydration becomes severe.

The treatment is simple enough in theory and in mild cases the restriction of carbohydrate—diet alone—may enable the remaining insulin of the pancreas to deal with sufficient carbohydrate to keep the urine sugar-free, the blood sugar approximately normal and the patient in good health. More severe diabetics have not even this minimal production of insulin and must be treated by injections of insulin prepared from animals. This may be given twice a day—in the form of the old, soluble, insulin, or once a day of the newer, protamine insulin which acts slowly and certainly for 24 hours. All accepted diabetic cases, however severe, can be kept well and in proper nutrition by the proper use of diet and insulin. The chief facts that concern the eyes are the poor healing qualities of the untreated diabetic and secondly, and perhaps more obviously, changes produced by dehydration and withdrawal of water from the eye.

A great number of changes have been observed in diabetes and though some of them are clearly due to the above factors, the aetiology of retinal changes is still completely obscure. The following are the chief changes observed by the use of the ophthalmoscope alone in some 10,000 diabetic cases, the majority of which have had a fairly careful eye examination by myself or colleagues.

1. Curious focusing changes in accommodation are found at some stage in most diabetics, if careful enquiry is made. Usually when acute diabetes is coming on myopia develops and persists for some 3-10 days when, in spite of no treatment and the continuation of the diabetic state—high blood sugar, glycosuria, etc., this disappears and the focus comes back to its previous state. On the other hand, when this excess of sugar is removed and the patient desugarised, either by diet, or diet and insulin, the opposite frequently occurs — hypermetropia develops (even up to +9 dioptres), the patient cannot read at all, and becomes greatly alarmed. This change too is temporary and disappears in about 10 days. There are no visible changes in the lens or different media of the eye and a full explanation of the phenomenon cannot be given, but it is obviously due to water or colloid changes, perhaps more in the vitreous than in the lens. At any rate, it is a grave mistake to fit these patients out with glasses which may be necessary for a day or two only and completely wasted later on. With such cases it has been my practice to supply them with some suitable Woolworth's glasses out of a box until they do not need them—a practice of which ophthalmologists may not approve!

2. Severe dehydration in precomatose conditions produces

great water changes in the eyes, the signs of which are very clear, but, of course, are seldom seen by ophthalmologists. The *eye tension* becomes extremely low and is quite diagnostic of diabetic coma. In some cases the eyeball can hardly be felt to the examining finger and Mr. Eric Lyle measured the tension in one case as only 7 millimetres of mercury (Schiotz).

I have described* the curious changes that can be seen in the lens, presumably from the withdrawal of water from it and shrinkage of its contents: the capsule looks wrinkled and quite dark opacities—becoming even total before death—can be seen with a +15 D. lens of the ophthalmoscope. With treatment—insulin and the replacement of body fluid—these changes rapidly disappear and leave no permanent effects. It is probable that a similar process takes part in the production of diabetic cataracts.

I have seen a few cases of the condition of rubeosis iridis which appears to be a complication unique to diabetes, but I am not in a position to know whether iritis and glaucoma are, on the whole, commoner in diabetics than in normal people.

Lens changes and opacification may be divided into two categories: the first, acute cataracts, which may develop within a few days—or certainly weeks—occur in young cases, children and adolescents, and, in my experience have developed in badly controlled cases. I have seen only a dozen of such cases and never seen them improved by diabetic treatment. When first seen opacification had occurred and most of these cataracts rapidly become opaque and require operation, which gives very good results. The second is the type of cataract which develops in so many elderly diabetics and there is still a dispute how much they are senile and how much they are diabetic—into which I shall not enter. The vast majority can be successfully operated on and in my experience the results are good, there being certainly no undue incidence of sepsis or haemorrhage. I gather that this is more likely to occur in badly controlled cases but as most of my patients are fairly well controlled under observation, I do not know what effect good or bad control has on the results and would be interested to hear the opinion of those present.

Retinitis is the complication I fear almost most in diabetics and it is extremely common. I have not gone fully into the statistics of my cases, but think 15 per cent.—mostly elderly—have this complication and in many it is already established when diabetes is first diagnosed. I am certain it occurs mostly in long-standing uncontrolled mild cases, and diabetics of short duration or under good control from the start develop it far less commonly. It has been disputed whether there is a true diabetic retinitis without arteriosclerotic or renal complicating factors. I have seen

*Lancet, p. 63, July 18, 1942.

hundreds of cases, however, with no other factors than sugar when the retinitis was discovered and am convinced of the reality of the syndrome. The first manifestations are punctate haemorrhages from venous radicles, deep in the retina and later, light exudates almost anywhere; later on the latter become intensely hard, white and thick, often edged with black pigment and very different from renal manifestations. Once the process is established it is checked, but not cured, by good diabetic control, and most of these cases retain moderate eyesight for many years although a few cases develop retinitis proliferans and go completely blind. It seems quite certain that the lesions are on the venous side of the vascular tree, that they occur through a damaged epithelium—exact cause unknown—but their frequency must be due to the relatively high venous tension (over 20 mm. mercury) which exists in the venous system of the eyes. Here is a great field for research.

I have seen about 10 cases of retrobulbar neuritis, clinically indistinguishable from tobacco amblyopia; 4 of them have occurred in non-smokers and were directly due to severe diabetes. In most cases the vision rapidly improves and, indeed, becomes normal when early and adequate diabetic treatment is given.

A not uncommon occurrence in diabetes is diplopia, usually from VIth nerve neuritis, again mostly in elderly cases and not necessarily accompanied by arteriosclerosis; they all get better in some 6-10 weeks, in my experience.

Finally, mention must be made of the functional changes that occur in vision during attacks of hypoglycaemia. When the blood sugar is reduced too low by an overdose of insulin, diplopia, misty vision, "flashes of light" and many quaint varieties of visual disturbances may occur and are often the first signs by which patients recognise the attack. There are no changes to be observed within the eyes and the basis of these disturbances is definitely in the brain cells whose function depends directly on glucose metabolism which is temporarily absent in hypoglycaemia.

These are the main changes I have noticed and the only ones I need outline. There is, however, one more point to which I should like to draw your attention. Most ophthalmologists I meet do not test urines nor take blood pressures and I do not see how without doing this they can come to an accurate diagnosis, increase their knowledge, and help the patients. It is not infrequent for me to see a patient in whom retinal haemorrhages had been recognised two years before, the case referred back to the doctor, but often the patient takes no further notice and in another year or two the retinitis has progressed so far without any treatment that the eyesight is already seriously damaged.

Miss Orr-Ewing said she personally had learnt much from this most excellent lecture, which cleared up many points of confusion in her mind. The lecture was now open to discussion.

Mr. J. M. Bickerton wondered if Dr. Lawrence had not laid perhaps a little excessive stress on the venous character of the retinal haemorrhages. He himself had often noted arterial haemorrhages. Quite frequently it was hard to say from what type of vessel a small haemorrhage was coming.

Dr. Wilfrid Oakley asked why so many eye men were chary of operating on diabetics, especially those with retinitis. He had one patient, blind with cataract; and several surgeons turned down the case. Eventually one, bolder than the rest, operated. In spite of the retinitis the visual result was very satisfactory to the patient. Did diabetics really do much worse than the generality of cases? Did careful control of the glycosuria really count for as much as was claimed? He had always taken meticulous care in his own cases; but wondered what would have happened if he had not been so careful.

Mr. Savin said that he was quite sure that lax control of the diabetes made results of operations much worse. There was much more post-operative iritis. Even in well-controlled diabetes post-operative iritis was a problem. That was partly why he now preferred intracapsular extractions for diabetic cataracts. He did not think diabetics bled much more than other folk. In his hands they took longer in healing.

He had seen one case of the wrinkled lens capsules of dehydrated diabetics which Dr. Lawrence described. In that case there was also wrinkling of Descemet's membrane.

Myopia in early diabetes could be a pitfall. He had fallen into the error of prescribing glasses for it, with subsequent complete alteration of the refraction when the diabetes was controlled.

He had been most unsuccessful in the treatment of rubeosis iridis and its sequel of glaucoma. Riboflavine did not seem to help and operation often proved disastrous.

Dr. Alkan said he thought it a fallacy to say that well-controlled diabetics healed more slowly than other cases. He asked whether lens opacities ever regressed under efficient diabetic treatment.

Mr. Lipschutz asked how the course of diabetic retinitis was affected by treatment?

Miss Lingfield asked whether vitamin K did any good in these cases?

Dr. Brigden stressed the importance of excluding other neurological conditions before diagnosing diabetic retrobulbar neuritis.

Dr. Lawrence in reply stated that he had no doubt arterial haemorrhages could often be discovered in those patients with concurrent arteriosclerosis. Nevertheless he thought the typical haemorrhage venous in origin. Many of his diabetic patients had had cataract extractions in many surgical hands. He was sure they were not often troubled by sepsis, perhaps through the pre-operative precautions taken. He could not claim sufficient acquaintance with normal cataract extractions to say whether diabetics were really more liable to haemorrhage. It was usually worth while removing an opaque lens, even where there was retinitis. Partly blind patients were grateful for small improvements. Treatment did not necessarily improve retinitis where established. He certainly thought retinitis patients travelled less rapidly towards blindness when under adequate treatment of their diabetes. He did not think lens opacities ever improved under medical treatment once protein coagulation had taken place in the opacity. Mere water clefts in a lens could of course disappear under treatment. Vitamin K had been extensively tried in diabetic retinitis. From what he read and could hear, it seemed of little value. With regard to the diagnosis of diabetes by the ophthalmoscope, he wished eye men would more frequently check up their suspicions of diabetes by testing urine and blood-pressures themselves. An early diagnosis of diabetes was of incalculable assistance to the patient.

ANNOTATIONS

πάντα ῥεῖ

The medical student who is said to have translated our heading into "everyone has a discharge" would hardly have been "sent up for good" in any well regulated school, for the true meaning is that everything is in a state of flux. It offers us a suitable heading for some reflections on the future of the profession. Far reaching changes are being ventilated in the press and it seems to be certain that after the war things cannot go on as they have in the past. Some are wholeheartedly in favour of a state controlled medical profession, both practitioners and hospitals, while others view the prospect of state control with dismay.

There are at least two sides to the question; first, the general public and secondly the profession; while the latter can be subdivided into consultants, public health officers and general practitioners. From the public view-point we think that the medical services hitherto provided have on the whole worked well, and from the practitioner's point of view, fairly well. It has often been said that no medical practitioner need starve, but most of those consultants who have started their careers without private means have had a very uphill struggle in the beginning. And few medical men manage to save enough to leave a fortune to their descendants. In favour of state control at first sight there would seem to be much to be said from the view-point of the general practitioner: regular working hours, a regular holiday, a guaranteed income and a pension on retirement. The scheme for pooling the medical resources of any district, so that no one is out of bed at confinements every night in the week, sounds well, but it rather overlooks the wishes of the patient, who may have asked Dr. X to attend her, and may not wish at the last moment to be put off with the services of Dr. Y. One of the bugbears of state control is the inevitable beaurocracy and the red tape which it entails.

The ophthalmologist is in rather a special position. Most of his work comes to his consulting room. As a rule he does not deal in parts of the body outside his own sphere; should he find evidence of general disease he usually communicates with the patients' medical attendant or suggests a physician or specialist as the case may be. So far we have been thinking of the more opulent types of patient. Those less well-off have also to be considered. Hitherto vast numbers of the poorer elements of the population have obtained their glasses through the sight-testing opticians. When it is a simple case of refraction or of presbyopia there is no reason to doubt that a large proportion of these are provided with suitable lenses.

As ophthalmologists it is our obvious duty to press for a proper ophthalmic service for all classes of the community by qualified medical practitioners with ophthalmic training who should receive an adequate fee for their work. A revision and extension of the National Ophthalmic Treatment Board would seem to be the ideal solution of our part of the problem.

We view with alarm the prospect of state control of the voluntary hospitals and we think that free choice of doctor must be accorded to the patient for the success of any scheme of re-organization of the health services. And, lastly, a similar freedom should be meted out to the medical practitioner. May we not agree with that great Scottish physician who, in one of his prefaces, said he thought, with Adam Smith, that a mediciner should be as free to exercise his gifts as an architect or a mole catcher?

A Singular Error

Madame de Staël's well known epithet *vulgaire*, applied to the writings of Jane Austen, was a blow which staggered lovers of the Hampshire novelist's books until some one suggested that the adjective in this case meant "commonplace" rather than "low." Thence onwards everything was comfortable. Our own comfort is often disturbed round about the beginning of each month by the fear that we have missed some dreadful howler in reading the proofs. Could a graph of our feelings be constructed it would show a regular rise and fall each month over a good many years with occasional excrescences above the common level where we have blundered more than usual. We regret to have to record that this happened in our October number, where, on page 436, occur the words "There *is* little or no *data*." We understand that this slip-shod construction is increasingly common in physical literature. That such a monstrous error should be prevalent is indeed a flaw in a centuries-long system of classical education. There is, however, no reason to despair, all will be well when the new Education Act is passed and we may look forward with confidence to the time when, in the words of our erudite Minister of Education, the boy well grounded in Latin will "take" (not only) "the internal combustion engine" (but also the whole range of physics) "in his stride."

ABSTRACTS

MISCELLANEOUS

(1) **Solandt, D. Y. and Best, C. H.—Night vision.** *Can. Med. Assoc. Jl.*, July, 1943.

(1) This paper deals principally with the problems of dark adaptation raised by the necessity of reading illuminated instruments and charts by men engaged in night operations, whether by sea, air or land. The lighting of aeroplane instrument boards by red light is described and the results stated to be favourable. In July, 1941, red lighting was introduced also on ships of the Royal Canadian Navy with equally good results and has been extended to the Royal Navy. The use of red goggles for 30 minutes before going on watch is important to reduce the time required to adapt to deck conditions. Various tests for dark adaptation are discussed and results obtained with the Hecht-Shlaer R.C.N. adaptometer described and tabulated. A description of the instrument and of the testing unit at Halifax, N.S. is given. 6,285 men were tested, and 1·6 per cent. of these were found to have defective dark adaptation. In order to check the accuracy of the method tests were repeated on groups of men daily for 6 to 8 days. The results were found to show only a standard deviation of 0·06 to 0·17 and therefore to be of value. It is to be noted, however, that in this as in most other tests for night vision the sensitivity of a small constant area of the retina only is measured. If the test is intended as an indication of a man's suitability for night operations it would seem desirable to design something which would measure the extent of the dark adaptated field of vision rather than the sensitivity of one point in it.

IDA MANN.

(2) **Tisdall, Wing Com. F. F., McCreary, Flight Lt. J. F., and Pearce, Wing Com. H.—The effect of riboflavin on corneal vascularization and symptoms of eye fatigue in R.C.A.F. personnel.** *Can. Med. Assoc. Jl.*, Vol. XLIX, pp. 5-13, July, 1943.

(2) Circumcorneal injection and corneal vascularisation have been investigated using a special camera which takes highly magnified photographs of any desired quadrant of the eye. Examination of these photographs, rather than of the eye itself, provides the data on which judgment of normality or abnormality has been based. A study of 198 men in the R.C.A.F., begun in May, 1942, using this method, showed that one only among them had what the authors considered to be normal eyes. Seventy men whose eyes

showed "proliferation of the vessels of the limbic plexus and penetration of the cornea with twigs, streamers and loops" were chosen to test the effect of riboflavin on such corneal vascularisation. Other symptoms which have been suggested by Kruse to be associated with riboflavin deficiency were also taken into account. Enquiries were made concerning tiredness, aching, or watering of eyes, sandy sensation under lids, dizziness, headaches, reading intolerance and decreased visual acuity.

The 70 men were divided into three groups. The first group of 28 men received 9·9 mg. riboflavin each day for two months. Photographs showed a marked or moderate decrease in vascularisation in 20 cases. None got worse. Twenty-one men received 9·9 mg. riboflavin each day for one month. Here again the photographs showed that 6 showed marked or moderate decrease in vascularisation. One man got worse. Of 21 men treated with capsules containing no riboflavin none showed more than faint improvement and 6 grew worse. Symptoms, apart from corneal vascularisation, also improved markedly under treatment with riboflavin, but not without.

This short summary of Tisdall, McCreary and Pearce's paper is sufficient to show either that the R.C.A.F. is in a very unbalanced nutritional state, or that photographs, like statistics, can prove anything. Of the two hypotheses the reviewer prefers the latter and would urge readers of this paper to bear it in mind while examining the photographs reproduced. Photographs 4, 5, and 6 of one normal and of two eyes showing very early stages of ariboflavinosis are difficult to assess by anyone unfamiliar with this photographic technique, but the corneae of all would pass as normal here if slit-lamp appearance is similar to photographic appearance. Photographs 7, 8, and 9 are of the same eye. This eye showed a "penetration of the cornea with twigs, streamers and loops" and photographs 7 and 8 give two pictures of the same quadrant before riboflavin treatment. Photograph 9 is the same eye and same quadrant after riboflavin. In all three photographs that part of the conjunctiva that is in focus is markedly engorged and by tracing out individual capillaries at the limbus, which in Fig. 9 is also largely out of focus, very little difference can be found between these three photographs.

The reviewer admits that inability to detect the difference may be due to poor reproduction of the photographs themselves. But if we accept unquestioningly the data in this paper the population of Canada—as a group of civilians also showed these signs—appears to be very much worse off than the population of Britain. Here very few cases of ariboflavinosis have been described, although it has been carefully looked for. The authors consider that it may be glare that is largely responsible for the susceptibility of the R.C.A.F.

to ariboflavinosis. Now, although riboflavin itself is light sensitive, the compounds of riboflavin, flavin adenin dinucleotide and flavoproteins, which occur in animal tissues, are not destroyed by light and no connection between snow blindness and riboflavin has been demonstrated as far as the reviewer knows. The symptoms which were used as ancillary evidence for ariboflavinosis can also result from errors of refraction or need not be of ocular origin, *e.g.*, dizziness and headache, or alternatively can be symptoms of photophthalmia with which the photographs are also consistent. It is noteworthy that the authors state that the changes in vascularity took place gradually over the two months of treatment. This is unlike the rapid effect of large doses of riboflavin in more advanced ariboflavinosis, where decrease in vascularity begins immediately.

The authors state that further work is in progress. The results will be awaited with interest as the reviewer feels that tongue and skin signs of ariboflavinosis and slit-lamp examination of the cornea are necessary before the presence of this very widespread malnutrition in Canada can be accepted as proved.

A, PIRRIE.

(3) **Kull, J. (Basle).—Prostigmin in the treatment of glaucoma.** **(Die Anwendung von Prostigmin in der Glaukombehandlung).** *Ophthalmologica, Vol. CIV, p. 23, July, 1942.*

(3) **Kull** reports that in the normal rabbit eye, prostigmin, like eserine, induces a fall in tension after a transitory rise. In glaucoma patients, prostigmin lowers the tension, sometimes even in patients in whom pilocarpine was ineffective. The best results were obtained in chronic simple glaucoma. Drops of 3 per cent. solution are well tolerated; exceptionally, 5 per cent. can be borne without irritation.

ARNOLD SORSBY.

(4) **Goldmann, H. and Hagen, R. (Berne).—The direct measurement of the total refraction of the living human eye. (Zur direkten Messung der Totalbrechkraft des lebenden menschlichen Auges).** *Ophthalmologica*, Vol. CIV, p. 15, July, 1942.

(4) **Goldmann** and **Hagen** report on the use of X-rays for the measurement of the actual length of the living eye by the procedure described by Rushton (*Trans. Ophthal. Soc. U.K.*, Vol. LVIII, *Pt. 1, p. 136, 1938*). They confirm Rushton's findings and give measurements of 18 eyes by an apparatus slightly modified from the original. They also discuss mathematical computation of the total refraction of the eye.

ARNOLD SORSBY.

BOOK NOTICE

The Fundamental Colour Sensations in Man's Colour Sense. By GUSTAF F. GÖTHLIN. With 21 figures. Kungl Svenska Vetenskapsakademiens Handlinger; Trenje Serien. Bd. XX, No. 7. Stockholm: Almqvist and Wiksells Boktryckeri-A-B. 1943.

The trichromatic theory of colour vision derives from Newton's laws of colour mixture. The three "elementary colours" were first held to be red, yellow, and blue (M. du Fray, 1737; Tobias Mayer, 1758). Wünsch (1792), from experiments with spectral lights, concluded that they were red, green and violet. Thomas Young (1802), the real founder of the "three components' theory," first chose red, yellow, and blue; but later in the same year substituted red, green, and violet. Clerk Maxwell's (1860) third "fundamental" colour was at the boundary between blue and indigo; whereas Helmholtz (1867) reverted to violet.

The trichromatic theory is founded upon the fact that all colour sensations, with very few exceptions, can be produced, though in more or less unsaturated form, by the mixture of three pure colours if these be chosen so far apart in the spectrum that the mixture of any two will not produce the third. There is therefore considerable opportunity of choice. The researches of Clerk Maxwell, König, Abney, Wright, and others do not settle which are the three fundamental colours. These experimenters choose wave-lengths which so far as possible eliminate negative quantities in the equations, since, as Wright says, "the negative values have no physical meaning." No choice of primaries suffices to eliminate negative quantities entirely, and they are very manifest in Clerk Maxwell's and Wright's "sensation curves." The author, who is a physiologist, advances the theory that they represent inhibitory impulses. The researches of Sherrington proving the existence of summation, facilitation, inhibition, and so on of impulses in the central nervous system afford some support for the theory, and further confirmation for the retina, which it should be remembered is an outlying portion of the brain, is found in the phenomena of simultaneous and successive induction or contrast. Still stronger support is obtained from Granit's experiments (1933) on the electrical responses of the cat's eye to light, showing the existence of a negative component of inhibitory character. Moreover, Hartline (1938) found in the frog's retina fibres which react only to interruption of illumination (the "off" discharge), a reaction promptly suppressed by re-illumination of the retina.

There is, indeed, a considerable body of evidence which the author does not mention showing that physiological processes must be

invoked in any theory of colour vision. For example, the sensation of "Brown" cannot be obtained directly from stimulation of the retina by any pure spectral rays or any admixture of such. It can be produced by mixing red or orange pigment with black pigment; but it can also be produced by receiving the pure spectral stimulus on a patch of retina in which the black after-image of a white light has been induced.

Further, the plotting of the sensation curves on a plane surface results in the familiar colour triangle. In any such triangle the red, and to a more doubtful extent the violet, are fully saturated, but the green angle of the triangle is very unsaturated. This indicates that there is a hypothetical green sensation far more saturated than spectral green. Anyone who has stimulated his retina with spectral green after previously stimulating it with the complementary purple will obtain a sensation of green which is much more saturated than any green which he has seen before.

The author, from other experiments—on individual variation in the position and range of pure yellow in the spectrum, and on the thresholds for colour sensation of monochromatic light within the indigo region of the spectrum—concludes that the fundamental colours are red, green, and blue. He further holds that "every impulse from the retinal receptors to a colour sensation is necessarily combined with a certain degree of central inhibition of the complementary colour in the same area, the degree of this inhibition being bounded by a certain law." The theory is illustrated by the help of a compound balance model.

CORRESPONDENCE

Re TREATMENT OF STREPTOTHRICOSIS CONJUNCTIVAE WITH GUTTAE SODIUM SULPHACETAMIDE 30 PER CENT.

To the Editors of THE BRITISH JOURNAL OF OPHTHALMOLOGY.

DEAR SIRS,—In May this year I saw a typical case of streptothricosis of the conjunctiva in a 14 months old male baby. The conjunctiva of the right lower lid was covered with many yellow-whitish nodules, which were so numerous that they gave the appearance of a pseudo membrane, which was adherent to the follicles of the conjunctiva. There was no discharge or watering of the eye, and the eyeball showed scarcely any conjunctival injection.

No yellow nodules were found on the upper palpebral conjunctiva, but a few follicles.

The left eye showed merely the picture of a follicular conjunctivitis, with a few yellowish nodules adherent to the lower palpebral conjunctiva. There was no swelling of the pre-auricular glands.

It was impossible to remove the nodules with gauze or cottonwool. The baby was otherwise in perfect health, and there was no history of any previous illness. A smear was taken, but did not show anything except for a few cocci. It was arranged to do a biopsy of the conjunctiva, and guttae sodium sulphacetamide, 30 per cent., were ordered in the meantime.

To my great surprise, the condition had completely cleared up when the child was seen a fortnight later. This is the more remarkable as the lesion is situated beneath the epithelium, and the usual treatment recommended is excision of the yellow nodules.

A short time later I saw an old lady with streptothrix concretions in the lower canaliculus. It had produced a conjunctivitis and a nasty corneal ulceration of the eye.

I removed a large, foul-smelling mass, which had the shape of a sausage, and measured twenty by three millimetres, from the canaliculus and lacrymal sac. Histological examination showed streptothrix, with secondary infection. Guttae sodium sulphacetamide, 30 per cent., cleared up the infection within three weeks.

I am, Sirs,

Your obedient servant,

J. A. MAGNUS.

25, HIGH PETERGATE, YORK.
September, 23, 1943.

NOTES

Royal Society of Medicine, Section of Ophthalmology

THE following dates have been arranged for the meetings of the Section of Ophthalmology of the Royal Society of Medicine.

November 12, 1943; February 11, March 31 and June 9, 1944, in each case at 5 p.m. Cases half-an-hour earlier. The March meeting it is hoped will be a joint meeting with the Ophthalmological Society of the United Kingdom.

Ophthalmological Society of Egypt. Ophthalmic Gold Medal

IN order to encourage scientific ophthalmic work the Ophthalmological Society of Egypt has instituted a gold medal for the most valuable contribution brought before the Society's Annual Congress each year. The value of the prize is L.E.20. Competition is open to all members of the Society of less than 20 years practice, whether staying in or outside Egypt. The subject for competition will not be selected, but is left open. Candidates who wish to enter for the prize should send their articles not later than December 1 in each year. Further information can be obtained from the Hon. Secretary of the Society, 42 Kasr el Ainy St., Cairo.

* * * *

American Ophthalmological Society: Officers 1943-44

President, John Green (St. Louis); *Vice-President*, S. Judd Beach (Portland); *Secretary*, Walter S. Atkinson (Watertown); *Editor*, Transactions, Wilfred E. Fry (Philadelphia); *Council*, John H. Dunnington (New York), Sanford R. Gifford (Chicago), Parker Heath (Detroit), Laurence T. Post (St. Louis), Everett L. Goar (Houston, Texas). There is also a committee on Theses and a programme committee. Dr. J. Milton Griscom, Chairman of the Council, died of coronary thrombosis a few days before the meeting, and Dr. J. H. Dunnington served as acting Chairman and has succeeded to his post this year.

* * * *

Royal Eye Hospital Clinical Society

A MEETING will be held on November 5, at 4.30 p.m. Mr. Harvey Jackson will speak on "Orbital Tumours."

* * * *

Research Scholarship

THE Mackenzie Mackinnon Research Fund Committee has appointed Miss J. M. Dollar, M.S., F.R.C.S., of the London School of Medicine and the Royal Eye Hospital to a research fellowship.

* * * *

Special Notice

WE are asked by the Ministry of Information to state that the fact that goods made of raw materials in short supply owing to war conditions are advertised in this journal should not be taken as an indication that they are necessarily available for export.